

IN THE CLAIMS:

Claims 1-5 (Canceled).

6. (Withdrawn) A fuel injector having a fuel inlet, a fuel outlet, and a fuel passageway extending from the fuel inlet to the fuel outlet along a longitudinal axis, the fuel injector comprising:

 a body having an inlet portion, an outlet portion, and a body passage extending from the inlet portion to the outlet portion along the longitudinal axis;

 an armature proximate the inlet portion of the body;

 a needle operatively connected to the armature;

 a swirl generator proximate the needle;

 a seat disposed at the outlet portion of said body, the seat including a first surface exposed to the body passage and a second surface exposed to an exterior of the fuel injector, the first surface being spaced from the second surface a defined distance along the longitudinal axis, the first portion having at least one cutout configuration that extends from the first surface for a fraction of the defined distance into an interior of seat.

7. (Withdrawn) The fuel injector of claim 6, wherein the at least one cutout comprises at least one volume that defines at least one wall in the interior of the seat.

8. (Withdrawn) The fuel injector of claim 7, wherein the at least one volume comprises one of a plurality of volumes and a channel.

9. (Withdrawn) The fuel injector of claim 8, wherein the swirl- generator comprises at least one flat disk;

 wherein the seat includes a seat passage, the seat passage including a funnel extending between the first surface and the second surface; and

wherein the needle includes a curved surface that engages with a conical end of the funnel to inhibit fuel flow through the seat passage of the seat.

Claims 10-19 (Cancelled)

20. (Currently Amended) A method of stabilizing temperature of a fuel injector in a direct injection application, the fuel injector having a body with a longitudinal axis; an armature proximate an inlet of the body; a needle operatively connected to the armature; a seat disposed at the outlet of the body; and a swirl generator proximate the seat, the method comprising:

providing the needle as an elongated generally cylindrical member with a substantially uniform cross-sectional area; and

selecting the body to surround the needle and form a body passage that communicates with and surrounds substantially an the entire length of the elongated, generally cylindrical member of the needle, the body passage maintains an operative relationship between the body and the needle, the body passage being part of a fuel passageway the permits fuel to pass from a fuel inlet to a fuel outlet of the fuel injector;

wherein fuel in the body passage transfers heat from the body directly to the needle to stabilize temperature of at least a portion of the fuel injector and to maintain an operative relationship between the body and the needle,

wherein the average cross-sectional area of the body passage is less than 2.25 times the substantially uniform cross-sectional area of the needle,

the method further comprising:

providing the seat separate from, but coupled with the body, the seat having with a first surface exposed to the body passage and a second surface exposed to an exterior of the fuel injector, the first and second surfaces being in generally parallel relation with each other and generally transverse with respect to the longitudinal axis of the body;

configuring at least one cut-out in the first surface to form a volume that extends into an interior of the seat and that is separate from the fuel outlet, wherein the at least one cut-out comprises a plurality of separated volumes, and each of the plurality of volumes is defined by a respective wall and each of the respective walls comprises a cylindrical side wall and an end wall; and

permitting fuel to enter the volume to collect in the interior of the seat and reduce an operative temperature of the seat.

21. (Canceled)

22. (Currently Amended) A method of stabilizing temperature of a fuel injector in a direct injection application, the fuel injector having a body with a longitudinal axis; an armature proximate an inlet of the body; a needle operatively connected to the armature; a seat disposed at the outlet of the body; and a swirl generator proximate the seat, the method comprising:

providing the needle as an elongated member with a substantially uniform cross-sectional area; and

selecting the body to surround the needle and form a body passage that communicates with and surrounds substantially an the entire length of the elongated member of the needle, the body passage maintains an operative relationship between the body and the needle, the body passage being part of a fuel passageway the permits fuel to pass from a fuel inlet to a fuel outlet of the fuel injector;

wherein fuel in the body passage transfers heat from the body directly to the needle to stabilize temperature of at least a portion of the fuel injector and to maintain an operative relationship between the body and the needle,

wherein the step of providing further comprises providing a substantially cylindrical member as the needle, and a cylindrical annulus as a neck of the body, the cylindrical annulus having an inner diameter that is

no more than 50% greater than substantially uniform diameter of the substantially cylindrical member, and an outer diameter that is no less than 100% greater than the inner diameter,

the method further comprising:

providing the seat separate from, but coupled with the body, the seat having with a first surface exposed to the body passage and a second surface exposed to an exterior of the fuel injector, the first and second surfaces being in generally parallel relation with each other and generally transverse with respect to the longitudinal axis of the body;

configuring at least one cut-out in the first surface to form a volume that extends into an interior of the seat and that is separate from the outlet, wherein the at least one cut-out comprises a plurality of separated volumes, and each of the plurality of volumes is defined by a respective wall and each of the respective walls comprises a cylindrical side wall and an end wall; and

permitting fuel to enter the volume and collect in the interior of the seat to reduce an operative temperature of the seat.

23. (Canceled)

24. (Canceled)

25. (Canceled)

26. (Currently Amended) The method of claim 22 24, wherein each of the plurality of volumes are disposed concentrically with respect to the needle.

27. (Previously Presented) The method of claim 26, wherein each of the plurality of volumes are disposed equiangularly about the needle.

28. (Withdrawn) The method of claim 23, wherein the at least one cut-out comprises an annular recess.

29. (Withdrawn) The method of claim 28, wherein the annular recess is disposed concentrically with respect to the needle.